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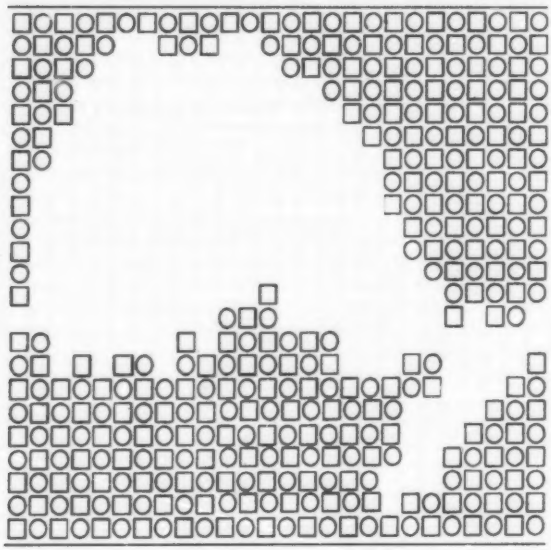
Designated Substances in the Workplace: A Guide to the Lead Regulation



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Designated Substances in the Workplace: A Guide to the Lead Regulation

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Introduction

The guide has been prepared to help employers, workers, members of joint health and safety committees, supervisors and occupational health personnel meet the requirements of the designated substance regulation respecting lead in the workplace and to understand the responsibilities this regulation places on all participants in the workplace health and safety system.

The advice in this guide is the interpretation, by officials of the Operations Division, of the *Occupational Health and Safety Act* (the *Act*) and regulations.

The advice does not have binding effect but is intended to provide general answers to possible questions asked in the context of a specific situation. It is being used by staff of the ministry to assist in the administration of the lead regulation.

Questions of construction and application will find their ultimate answer given by the courts where a contest ensues as to construction or application of a legislative provision.

The Operations Division of the Ministry of Labour is responsible for administering the *Act*. One of the oldest recognized occupational hazards, lead became the first designated substance to be regulated under the *Act*. The Regulation respecting Lead, Ontario Regulation 536/81 (now Regulation 843 of the Revised Regulations of Ontario, 1990) was filed with the Registrar of Regulations on August 14, 1981. The provisions relating to the assessment came into force on the date of filing; those relating to control measures came into force on November 12, 1981.

This guide is intended as a supplement to the booklet entitled *Designated Substances in the Workplace: A General Guide to the Regulations* to help employers meet the requirements of the lead regulation. It reviews the health effects of lead, its uses and the forms of workplace exposure. In addition, it provides information on the application of the regulation, allowable exposure levels, the assessment and control program and medical surveillance.

It is important that both this guide and the general guide to the regulations referred to above be consulted.

1. The Hazards of Lead in the Workplace

What is Lead and How is it Used?

Lead is a heavy metal that has been used industrially for thousands of years. It is pale silvery grey when freshly cut but it darkens on exposure to air. It is heavy, malleable, and a poor conductor of electricity. Lead may be used in its pure elemental form or combined chemically with other elements to form lead compounds.

Elemental lead is used to make products such as electric storage batteries, ammunition, lead solder, radiation shields, pipes, and sheaths for electric cables. Lead is sometimes combined with other metals such as copper, tin and antimony to make lead alloys for use in the manufacture of a variety of metal products.

Organic lead compounds contain a lead atom covalently bonded to carbon in an organic molecule. The most widely used organic lead compounds are tetraethyl lead (commonly known as TEL) and tetramethyl lead (commonly known as TML). These are colourless, oily liquids used as anti-knock agents in gasoline. Other organic lead compounds include lead "soaps" such as lead oleate, naphthenate and stearate used as high pressure lubricants.

Inorganic lead compounds (or lead salts) result when lead is combined with an element other than carbon. Examples are lead oxide, lead chromate, lead carbonate and lead nitrate. Inorganic lead compounds may occur as solids or liquid solutions, and are used in insecticides, pigments, paints, frits, glasses, plastics and rubber compounds.

Why is Lead a Health Hazard?

Lead can cause serious damage to a number of systems in the body. These harmful effects are preventable by diligent adherence to a comprehensive lead control program.

Overexposure to lead can affect:

The Blood: Lead can interfere with the body's ability to manufacture hemoglobin, the molecule in red blood cells responsible for carrying oxygen to the tissues.

The Kidneys: Lead can reduce the ability of the kidneys to filter wastes from the bloodstream.

The Gastrointestinal System: Lead poisoning may result in complaints of abdominal pain, loss of appetite, vomiting, nausea, constipation or diarrhea.

The Nervous System: Lead can cause peripheral nerve damage that results in muscle weakness. It may also lead to behavioural changes and to impairment of vision and hearing. At very high levels, lead can affect the brain, causing convulsions, coma, and even death.

The Reproductive System: Lead may harm the developing fetus and may cause impaired sperm production.

Like many other poisons, lead may be harmful following a high dose received in a short period of time (acute poisoning), or after long-term exposure to lower doses (chronic poisoning).

Symptoms of **acute lead poisoning** include a metallic taste in the mouth and gastrointestinal symptoms such as vomiting, abdominal cramps, constipation or diarrhea. The major effect of acute organic poisoning by either TEL or TML is on the central nervous system, with symptoms such as disturbed sleep, headache and psychosis.

The earliest signs of **chronic lead poisoning** may not be noticed because they are similar to many common complaints. These include headaches, fatigue, irritability, pains in joints and muscles, abdominal pain and constipation. More severe chronic poisoning leads to several characteristic symptoms, including a blue line on the gums, wrist drop (the inability to hold the hand extended), severe abdominal pain and pallor.

Although all forms of lead are potentially harmful if absorbed, some are more toxic than others. However, it is the amount of lead that enters the body that really matters. This is largely dependent on the solubility and physical form of the lead. For example, fine lead dust or powder is a major hazard whether it is pure lead or a lead compound such as lead oxide.

What Forms of Lead Can Be Dangerous to Workers?

Lead may affect the health of workers if it is in a form that may be inhaled, ingested or absorbed through the skin.

1. **Lead dust** consists of small, solid particles of elemental lead or lead compounds. Dust may be created through processes such as:
    - dry sanding
    - grinding
    - polishing
    - mining
    - crushing
    - mixing
    - sawing.

    It also may be present wherever powdered forms of inorganic lead compounds are used, as in the manufacture of lead batteries. Dust particles smaller than one micrometre (1/1,000,000 metre) in diameter normally remain suspended in air for long periods of time, while larger particles tend to settle close to their source.

2. **Lead fume** is produced in significant amounts when solid lead or materials containing lead are heated to temperatures above 500°C, as in:
    - smelting
    - refining
    - casting
    - welding
    - flame cutting and burning.

    At high temperatures molten lead gives off vapour, which condenses to form a fume. Some of the fume may combine with oxygen in the air to form lead oxide. Fume consists of solid particles invisible to the naked eye, which can remain suspended in the air for long periods of time. The production of fume can be reduced by keeping process temperatures below 500°C where possible.

3. **Lead-containing mists** consist of small, liquid droplets suspended in the air. Mists may be produced through processes involving the spraying, foaming, bubbling or boiling of lead compounds. Spray-painting lead paint, for example, can generate a high concentration of lead-containing mist.

4. **Liquids** such as TEL or TML or lead "soaps" may be hazardous if they come into direct contact with the skin. Organic compounds are easily absorbed through the skin and thus present a greater absorption hazard by this route than inorganic compounds of lead.

5. **Vapours of liquid organic lead compounds:** "Vapour" refers to the gaseous form of a material that has been given off (evaporated) from a liquid. The "volatility" of a liquid refers to the rapidity with which it is changed to vapour. The higher the temperature of the liquid, the more rapidly it will vaporize and the more vapour it will release in a given time. TEL and TML are both very volatile liquids that release sweet-smelling vapours. Exposure to organic lead vapours may occur at any

point of production or use, but is particularly a danger when working in confined spaces, as when cleaning or maintaining storage tanks that contain organic lead compounds.

How Is Lead Absorbed into the Body?

Lead may enter the body through inhalation, skin absorption or by ingestion:

1. Inhalation:

Much occupational exposure to lead occurs through breathing airborne vapours, fumes, dusts and mists. Lead fumes and dusts of elemental lead and lead compounds are the most commonly inhaled forms.

The most dangerous form of dust is made up of particles too small to be seen by the naked eye (smaller than five micrometres or 5/1,000,000 metre in diameter). Such dust is especially hazardous as the particles can penetrate deeply into the lungs. About 30 per cent to 40 per cent of inhaled inorganic lead and 80 per cent of organic lead can pass from the lungs into the bloodstream and be carried to other parts of the body. The more soluble the lead compound, the more rapidly it will be absorbed.

2. Absorption through the skin:

Organic lead compounds such as TEL or TML can readily penetrate the skin. Some organic lead compounds, including lead "soaps" such as lead naphthenate, are soluble in oils and can penetrate the skin quite easily. Most inorganic lead compounds do not penetrate healthy skin to a significant degree. However, skin that has been cut or scraped may offer less resistance to the absorption of lead-containing materials.

3. Ingestion:

Many workers have developed lead poisoning by unknowingly ingesting lead, in any of its forms. This may occur if food, drink, chewing gum or tobacco products are brought to the work area and directly contaminated. Lead poisoning also results from eating or smoking with lead-contaminated hands. If hygiene practices are not observed after leaving a work area, lead dust that has collected on workers' clothing, skin or hair may be transferred to food or tobacco products. Lead may also be ingested when inhaled lead particles are deposited in the upper respiratory tract and subsequently swallowed.

About five per cent to 15 per cent of ingested inorganic lead is absorbed into the body through the gastrointestinal tract. The extent of absorption depends on a number of factors, including diet and the solubility of the ingested compounds.

Ingestion of organic lead compounds, such as lead soaps or lead naphthenate, may occur when food is eaten in a contaminated area. Absorption of organic lead compounds from the gastrointestinal tract is believed to occur easily.

2. The Lead Regulation

Who Is Covered by the Lead Regulation?

With the exception of construction projects (explained below), every employer and worker at a workplace where lead is present, and at which a worker is likely to inhale, ingest or absorb lead, is covered by the lead regulation.

Does the Regulation Apply to Construction Projects?

If the construction project is located at a workplace where lead is present and likely to be inhaled, ingested or absorbed by a worker, then the employer responsible for the workplace must protect the workers on the project by obeying the instructions set out in sections 4 and 5 of the regulation. (Sections 4 and 5 state how much airborne lead the worker may be exposed to with safety and describes when, and in what circumstances, respirators must be used in order to meet these requirements.)

Other construction projects are not covered by the regulation.

What Are the Allowable Airborne Concentrations of Lead?

The worker must not be exposed to a lead level greater than that specified in the regulation:

Time-Weighted Average Exposure Concentration

The time-weighted average exposure of a worker to **all lead except tetraethyl lead** must not be greater than **0.05 milligrams per cubic metre (mg/m^3)** of air.

The time-weighted average exposure of a worker to **tetraethyl lead** must not be greater than **0.10 mg/m³** of air.

The time-weighted average exposure of a worker is calculated on the basis of cumulative weekly exposure (40 hours) and cumulative daily exposure (8 hours), as indicated in the Schedule appended to the regulation.

Maximum Exposure Concentration

The maximum exposure to **tetraethyl lead** must not be greater than **0.30 mg/m³** of air at any time. The exposure of a worker to this maximum concentration must:

- not last longer than 15 minutes at any one time;
- not occur more than four times in a work day; and
- not occur until at least 60 minutes after the last previous exposure to such concentration.

3. Assessing and Controlling Exposure to Lead

The Assessment

Chapter 2 of *A General Guide to the Regulations* describes how to assess the extent to which workers are exposed to lead. When you are carrying out this assessment, you must note all processes involving lead and the forms in which lead is likely to be released into the workplace. As well as being aware of all possible sources of airborne lead, you must watch carefully for situations that may result in ingestion or skin absorption of lead. Wherever lead dust may be created, pay particular attention to housekeeping, work practices, and hygiene practices and facilities.

Tables 1 and 2 present a list of industrial processes or operations that have varying potentials for worker exposure to lead. Any work or operation of this nature should be carefully assessed for potential for lead exposure.

It may be necessary in some cases to include air sampling as part of the assessment for lead. Chapter 6 of *A General Guide to the Regulations* explains in detail the procedures for air monitoring that should be used to determine the concentration of lead in workplace air.

TABLE 1

TYPES OF WORK WITH POTENTIALLY SIGNIFICANT EXPOSURE TO LEAD
(if adequate controls are not provided)

A. **Work with Elemental Lead**

- lead smelting, refining (including refining of lead scrap), melting, casting
- lead burning, welding or solder filling
- lead grinding, dry discing or cutting by power tools
- manufacture and pouring of lead alloys such as bronze and leaded iron
- babbitting
- the smelting of materials containing elemental lead or compounds of lead
- stereotyping with lead
- lead metallizing
- extrusion and cutting of lead
- firing of small firearms on firing ranges
- wire-patenting

B. **Work with Inorganic Lead Compounds**

- pigment manufacture
- manufacture of inorganic lead compounds
- mixing of inorganic lead powder
- use of lead arsenate as a pesticide

TABLE 1 (Cont'd)

C. **Work with Organic Lead Compounds**

- soil remediation in and clean-up of leaded-gasoline storage sites
- manufacture of organic lead compounds

D. **Work with Lead Paints**

- operations in which oxyacetylene flame is used on paint containing elemental lead or compounds of lead, e.g., ship breaking
- the manufacture or spray application of paint containing inorganic lead
- scraping, sanding, grinding or cutting of lead-painted materials

E. **Manufacturing using Lead**

- the manufacture or reclamation of storage batteries containing inorganic lead
- the production of ceramics, glaze, enamel or glass using inorganic lead compounds
- manufacture of detonators
- the processing of plastics or rubber containing lead

F. **Maintenance**

- the alteration or repair of equipment used for the processing or conveying of lead or lead compounds
- the alteration or repair of equipment used to manufacture storage batteries, lead paints, lead pigments
- alteration or repair of equipment used to cut, grind or melt lead

TABLE 2

TYPES OF WORK WITH SOME POTENTIAL FOR LEAD EXPOSURE

- plumbing (handling of solid elemental lead)
- linotype and monotype casting processes in printing industry (work done below 500°C)
- painting with low solubility lead paints
- the use of oil bound lead paints and some stabilizers for plastics, where moisture content prevents formation of dusts and fumes
- metal-stockpiling of lead pipes or ingots
- mining of galena (lead sulphide)

The Control Program

Engineering Controls

If a lead control program is required, it must include engineering controls to reduce the exposure of workers to lead. These controls can be grouped into the categories outlined in Chapter 4 of *A General Guide to the Regulations*. Examples of appropriate controls for some types of lead operations are indicated on the process flow sheets included in Appendix 1 of this guide.

Product Substitution

It may be possible to eliminate lead from the workplace by replacing it with a less poisonous material. Substitutes may be found, for instance, for lead pigments in paint, ceramic glazes and printing inks. Pesticides containing lead can be replaced by other pesticides.

Meanwhile, substituting one product containing lead for another can reduce the exposure hazard in some cases. For example, lead alloys that generate fumes can be replaced by alloys that do not fume. Liquid lead compounds that are rapidly vaporized can sometimes be replaced by liquids that are less volatile. Lead compounds that do not readily dissolve in water are generally not as hazardous as compounds that do. Dust from powdered lead compounds can be prevented if these compounds are mixed with liquid to form an emulsion or paste.

Process Changes

In some situations, lead exposure can be reduced through changes in production methods. For instance:

- Abrasive operations that produce a coarse dust are less hazardous than those that produce a fine dust. Coarse dusts settle more readily and are less likely to be absorbed into the body if inhaled. The substitution of manual filing or sanding for a mechanical process will result in the production of a coarser dust.
- Wet methods should be used to reduce dust. For example, the wetting of lead oxide powder in battery manufacture can significantly reduce airborne lead dust. Wet methods can also limit the dust created by abrasive operations such as grinding, scraping and filing.
- Brush painting or dipping can replace spray painting operations.
- Lead fume can be greatly reduced if processes involving molten lead are kept at temperatures below 500°C.
- Processes can be designed to include warning signals wherever possible. Alarms can be installed to warn of high pressure, low or high temperature, pump failure, low or high levels and failure of ventilation systems.

Enclosure/Isolation

Processes should be designed so that lead materials are kept in enclosed systems wherever possible. Lead materials should always be stored and moved in tightly sealed containers. Enclosure is especially important for the liquid organic lead compounds-particularly TEL, which is highly toxic and very volatile.

Some enclosed operations require continuous exhaust to prevent build-up of lead. Exhausting of enclosed vessels can also create a slight vacuum, which ensures that any leakage of air will be inward. For example, mixing, grinding, crushing, screening and sintering operations that generate lead dust or fume should be conducted in enclosed vessels provided with exhaust systems. Lead furnaces should also be tightly enclosed and provided with exhaust installations to vent fumes.

Operations such as spray painting that generate high concentrations of respirable lead dust or mist should be performed in well-ventilated enclosed booths by operators with appropriate protective equipment. Where lead is used in only some of the processes performed at a workplace, these operations should be segregated from other areas of the plant.

Ventilation

Local exhaust ventilation must be provided for all lead operations where other methods do not prevent exposure. Hoods must be located as close to the source of emissions as possible. Local exhaust ventilation is normally provided for mixing, spraying, grinding, sanding, cutting, heating, drossing and binding operations. Operations such as pouring may require movable hoods.

Regular maintenance and cleaning of air filters are essential to keeping the ventilation system operating as it should. Strict precautions are required when recovering lead from air filters—careless recovery can be a source of lead exposure both for workers

and the community. Lead recovered from the ventilation system, if not recycled, must be transported in sealed containers to a disposal site approved by the Ministry of the Environment.

It is often difficult to completely eliminate airborne lead through local exhaust ventilation alone. Therefore, good general ventilation is important to dilute air contaminants.

Work Practices and Hygiene Practices

In order to avoid the unconscious ingestion of lead and the unintentional transfer of lead from contaminated areas it is essential that good hygiene practices (as outlined in Chapter 4 of *A General Guide to the Regulations)* are strictly followed. Hygiene facilities with a "double locker" system are required whenever there is significant exposure to lead dust. Training programs must stress the importance of avoiding touching lips or nose with contaminated hands and of thorough washing before eating. Smoking, eating, drinking or chewing in contaminated areas must be strictly forbidden. Lunches must be stored in an uncontaminated area.

Housekeeping Measures

Good housekeeping is crucial wherever there is lead dust. Lead dust must be cleaned from machinery, floors, ledges and other surfaces daily by wet sweeping or vacuuming. Vacuum cleaners should be fitted with a high-efficiency (HEPA) filter designed to trap lead dust. Scrap receptacles for material containing lead dust should be kept tightly covered to prevent dust from becoming airborne. Exhaust ventilation of scrap containers may be necessary.

Keeping floors wet can help to control dust levels. Cleaning and wetting of floors should be done with a fine spray of water to avoid stirring up dust. The use of floor grates placed over flowing water can be an effective means of capturing dust.

Vehicle wheels and footwear should be hosed down before leaving lead-contaminated areas so that the dust is not transported to other areas of the workplace.

Protective Clothing

Clothing designed to protect against exposure to liquid organic lead compounds should include face and hand covering made of impermeable material such as polyvinyl chloride (PVC) or neoprene. For work in a lead organic vapour atmosphere, a totally enclosed air supplied suit must be used.

When the purpose of protective clothing is to prevent the spread of contamination by lead dust, clothing should be made of material designed to reduce dust retention. Specially treated nylon fibres have been developed for this purpose. Such clothing should feature close-fitting neck and arm openings, which can help to prevent dust penetration. All clothing, including footwear that has been worn in a lead-contaminated area, must be removed at the end of a shift and be decontaminated. Under no circumstances should it be taken home. Lead poisoning has occurred among family members exposed to lead brought home on work clothes.

After clothing is removed, it should be placed in sealed bags that have labels indicating lead contamination. Lead-contaminated clothing should be handled and shaken as little as possible, as this can be a significant source of exposure to lead dust. Washing facilities and procedures must be suitable for handling lead-contaminated laundry. The use of acetic acid in the wash water is a great help in removing lead from clothing.

Respiratory Protection

The type of respirator that should be worn to protect against exposure to lead depends on the form and concentration of the lead in the air. The *Code for Respiratory Equipment for Lead*, which is

referenced by the regulation, specifies the type of respirator required for different conditions of exposure. The pertinent section of that code follows. Use of respirators should conform to the practices advised in Chapter 5 of *A General Guide to the Regulations*.

The Type of Respirator Required

The respiratory equipment provided by an employer and used by a worker must meet or exceed the following requirements:

(1) **Lead: (elemental lead, inorganic lead compounds and organic lead compounds other than tetraethyl lead and tetramethyl lead)**

Airborne Concentration	Type of Respirator Required
Less than or equal to 0.5 mg/m^3	Half-mask particulate respirator with N-, R-, or P-series particulate filter and 95, 99 or 100% efficiency.
Less than or equal to 1.25 mg/m^3	Powered air purifying respirator equipped with a hood or helmet and any type of particulate filter, or supplied air respirator equipped with a hood or helmet and operated in a continuous flow mode (see note 1).

(2) Tetraethyl Lead:

Less than or equal to 1 mg/m^3	Supplied air respirator equipped with a half mask and operated in a demand (negative pressure) mode. However, air purifying half mask respirator equipped with organic vapour cartridge may be used where mobility is important and exposure is short term.
Less than or equal to 2.5 mg/m^3	Supplied air respirator with a hood or helmet and operated in a continuous flow mode.

Notes:

1. Respirators with higher protection factors or required for protection from higher airborne concentrations of lead or tetraethyl lead must be selected in accordance with the NIOSH assigned protection factors as given in Tables 1 and 2 of its publication entitled *NIOSH Respirator Decision Logic* dated May 1987; and respirators for escape must be selected in accordance with Table 4 of this NIOSH publication.

2. Respirators need not be worn if the levels of lead or tetraethyl lead in air are less than their respective TWAEVs (0.05 mg/m^3 for lead and 0.1 mg/m^3 for tetraethyl lead). However, if a worker wishes to use a respirator at exposures less than the TWAEV, the correct type of respirator must be worn.

4. Medical Surveillance for Exposure to Lead

The lead regulation requires that the control program provide for a medical surveillance program, which must include:

- pre-employment, pre-placement and periodic medical examinations;
- clinical tests;
- health education;
- record keeping.

The medical surveillance program is outlined in detail in the *Code for Medical Surveillance for Lead* and is designed to protect the health of workers through educating all staff to the health hazards associated with lead exposure.

The objectives of the medical surveillance program are both preventive and remedial. Medical conditions that may be aggravated by exposure to lead should be detected at the pre-placement and periodic examinations. By providing a regular check on workers exposed to lead to detect subsequent adverse health effects, the examining physician can alert the employer and the joint health and safety committee to exposure problems in the workplace that might otherwise go unrecognized. This should ensure that remedial steps will be taken. Health education for workers on the health effects of lead and the manner in which exposure can be limited are also preventive functions of the program.

Section 3 of the Code explains what the physician should look for at the pre-placement and periodic medical examinations. Medical

records kept by the physician should include the information listed in section 7 of the Code.

Clinical Tests

Section 4 of the Code explains clinical tests that are used in assessing the worker's lead exposure and fitness for continued exposure to lead. These include lead absorption tests, which measure lead concentration in blood and urine, and heme synthesis interference tests, which detect biochemical changes resulting from the effect of lead on the synthesis of hemoglobin (the chemical in red blood cells that carries oxygen throughout the body).

The concentration of lead in blood, expressed as either milligrams or micromoles per litre (mg/L or μmol/L) of blood, is a good indicator of recent absorption of elemental or inorganic lead. It is not considered a reliable indicator of exposure to organic lead. Because lead absorbed by the body is ultimately stored in the bone and other tissues, the blood lead concentration does not indicate cumulative lead absorption.

The concentration of lead in urine is not considered as reliable as lead in blood for indicating the amount of inorganic lead that has been recently absorbed. It is, however, the only test that can be used to assess exposure to tetraethyl or tetramethyl lead.

Action Levels

The Code specifies action levels for the concentration of lead in blood and urine.

1. Blood

Unless the worker is a woman capable of bearing children, when a worker's blood lead level reaches 0.60 mg/L (2.9 μmol/L), an enquiry into work practices and personal hygiene must be made. Workers whose blood lead level is rising or fluctuating or exceeds 0.60 mg/L (2.9 μmol/L) should be monitored more frequently.

When the blood lead level exceeds 0.70 mg/L (3.4 μmol/L), a second test must be taken at once. If this test also shows levels above 0.70 mg/L (3.4 μmol/L), the worker must be removed from lead exposure.

A woman capable of bearing children must be removed from lead exposure when her blood lead level exceeds 0.40 mg/L (1.9 μmol/L).

A worker who shows symptoms of lead intoxication must be removed from further exposure to lead, regardless of the results of clinical tests.

With the exception of a woman capable of bearing children, a worker who has been removed from lead exposure may return to his or her usual work when the blood lead level drops to 0.50 mg/L (2.4 μmol/L). A woman capable of bearing children who has been removed from lead exposure may return to her usual work at the discretion of the physician.

2. Urine

If a worker is exposed to inorganic or elemental lead and the concentration of lead in urine is found to exceed 0.15 mg/L (0.72 μmol/L), then the urine test must be repeated. If the urine lead level is confirmed, then a blood test must be performed immediately. If the blood lead concentration exceeds 0.70 mg/L (3.4 μmol/L), the worker must be removed from lead exposure. If a worker is exposed to tetraethyl or tetramethyl lead and the concentration of lead in urine exceeds 0.15 mg/L (0.72 μmol/L) on a repeat test, then the worker must be removed from lead exposure.

A worker who has been removed from exposure may return to usual work when the examining physician determines, on the basis of a physical examination, that the worker is fit to do so.

Chelating Agents

The treatment of lead poisoning must be done only under the supervision of a physician. Chelating agents are powerful drugs that have been used for the elimination of lead from the body. They must not be used as a general control measure, and are to be administered only under careful medical supervision.

Analysis of Samples

The *Code for Medical Surveillance for Lead* explains the methods that should be used to collect blood and urine samples. The analysis of these samples should employ procedures that are in accordance with standard methods for the measurement of lead in clinical samples. The employer must pay for these analyses and also make certain that the analytical methods used by the laboratory satisfy the requirements of the regulation.

For further information on any aspect of the lead regulation, contact the appropriate Ministry of Labour office. The addresses and telephone numbers of Ministry field offices are listed in the appendix.

The Examining Physician

The lead regulation does not stipulate who shall be the examining physician, thus allowing the worker to select the doctor of his or her choice. As a result, the examining physician may be the company doctor, a private consultant with whom the employer contracts services, a physician on the staff of a clinic or the personal physician of the worker. Every examining physician must know the content of the *Code for Medical Surveillance for Lead* and his or her responsibilities. Where there is more than one examining physician, a physician should be appointed in a co-ordinating role. The role of the co-ordinating physician, who should be selected jointly by the employer and the joint health and safety committee, should be to standardize examination and test procedures, maintain

medical records and identify any trends in examination and test results.

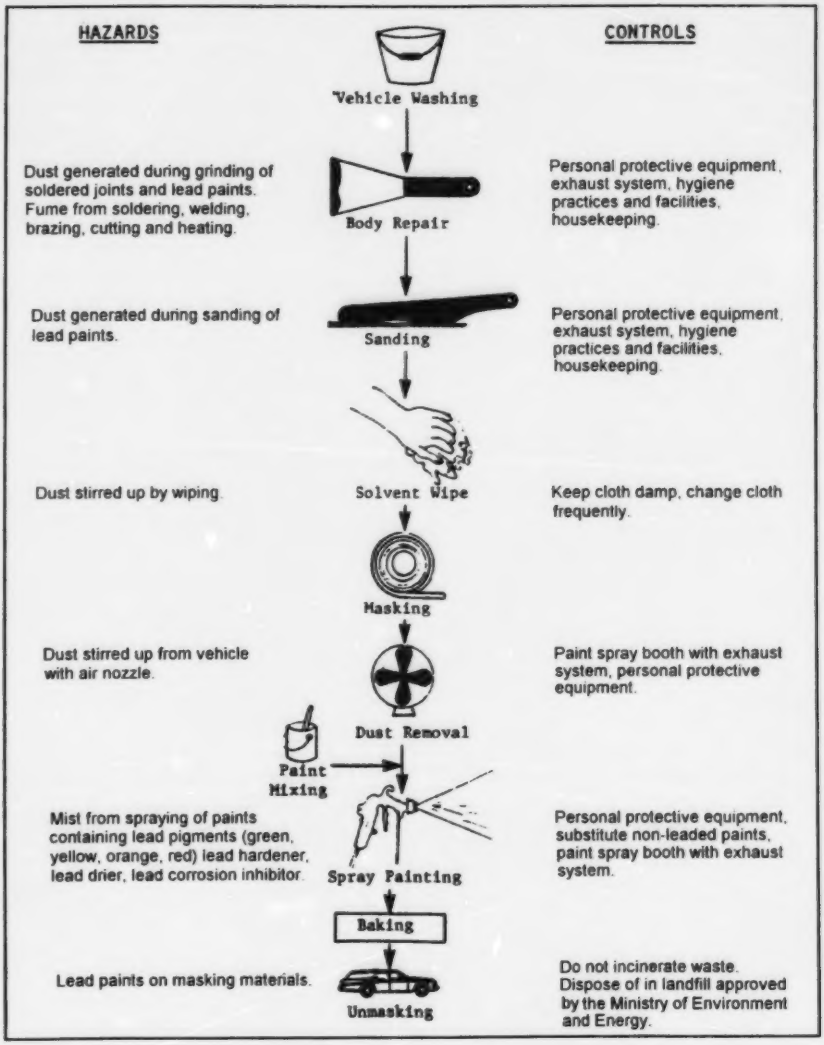
Physicians Reporting Protocol

The regulation requires the examining physician to advise the employer whether the worker is fit, fit with limitations or unfit for exposure to lead. This determination is a professional judgement based on the results of medical examinations and clinical tests. **The physician must give this opinion without disclosing to the employer the results of the examinations or tests.**

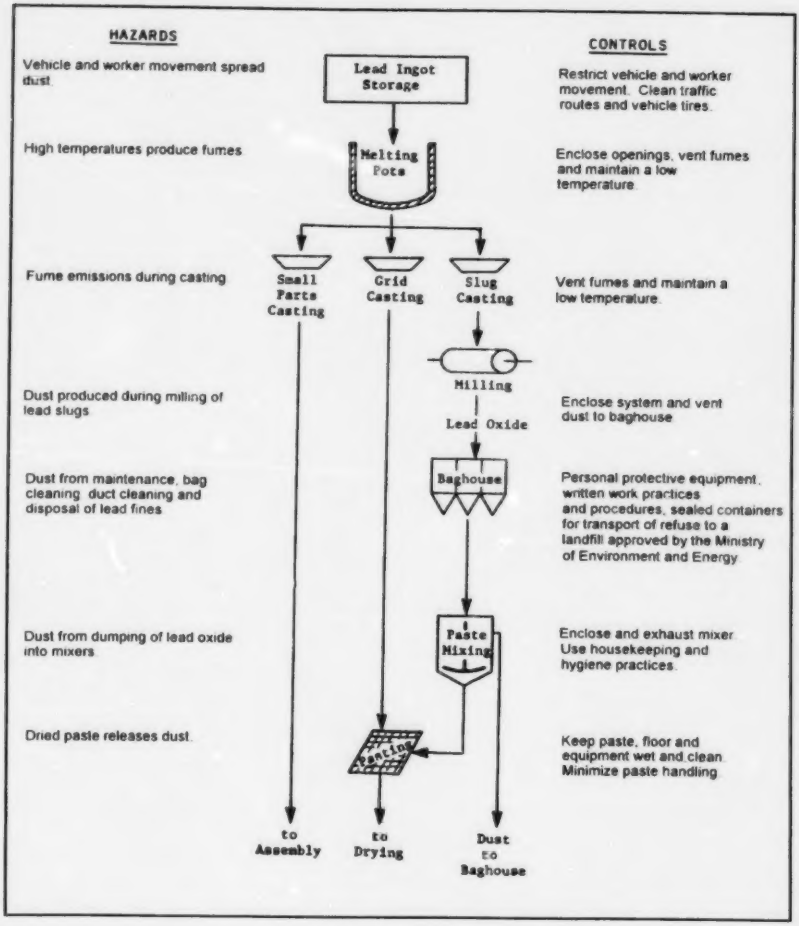
The designated substance regulation for lead requires the physician to advise the committee in writing of the results of clinical tests, along with an opinion as to how these tests should be interpreted and an opinion as to the fitness of the worker for exposure. In all such cases, the committee must receive this information on a confidential basis. If the physician has advised the employer that a worker is fit with limitations or unfit, he or she must also report this information to the Provincial Physician of the Ministry of Labour. These requirements are specified in sections 16(l), 16(2) and 16(5) of the regulation.

Appendix 1 - Process Flow Sheets

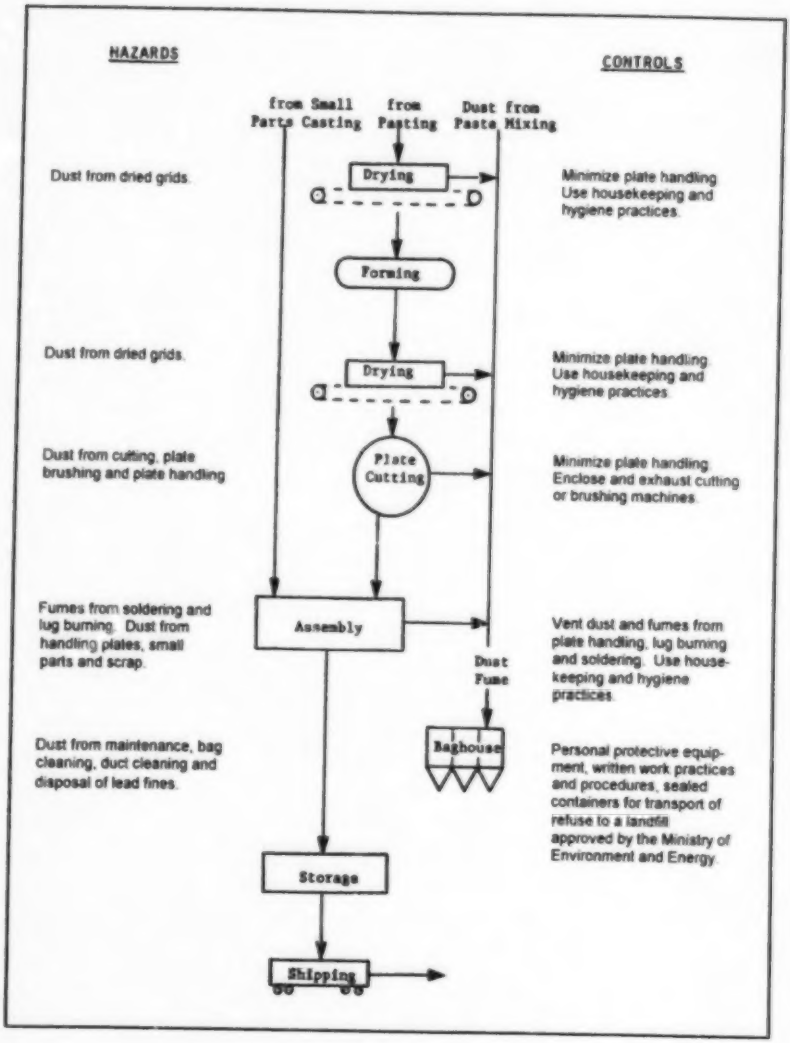
PROCESS FLOW SHEET FOR AUTOMOBILE REFINISHING


HAZARDS
CONTROLS
Vehicle Washing
Dust generated during grinding of soldered joints and lead paints. Fume from soldering, welding, brazing, cutting and heating.
Body Repair
Personal protective equipment, exhaust system, hygiene practices and facilities, housekeeping.
Dust generated during sanding of lead paints.
Sanding
Personal protective equipment, exhaust system, hygiene practices and facilities, housekeeping.
Dust stirred up by wiping.
Solvent Wipe
Keep cloth damp, change cloth frequently.
Masking
Dust stirred up from vehicle with air nozzle.
Dust Removal
Paint spray booth with exhaust system, personal protective equipment.
Paint Mixing
Mist from spraying of paints containing lead pigments (green, yellow, orange, red) lead hardener, lead drier, lead corrosion inhibitor.
Spray Painting
Personal protective equipment, substitute non-leaded paints, paint spray booth with exhaust system.
Baking
Lead paints on masking materials.
Unmasking
Do not incinerate waste. Dispose of in landfill approved by the Ministry of Environment and Energy.

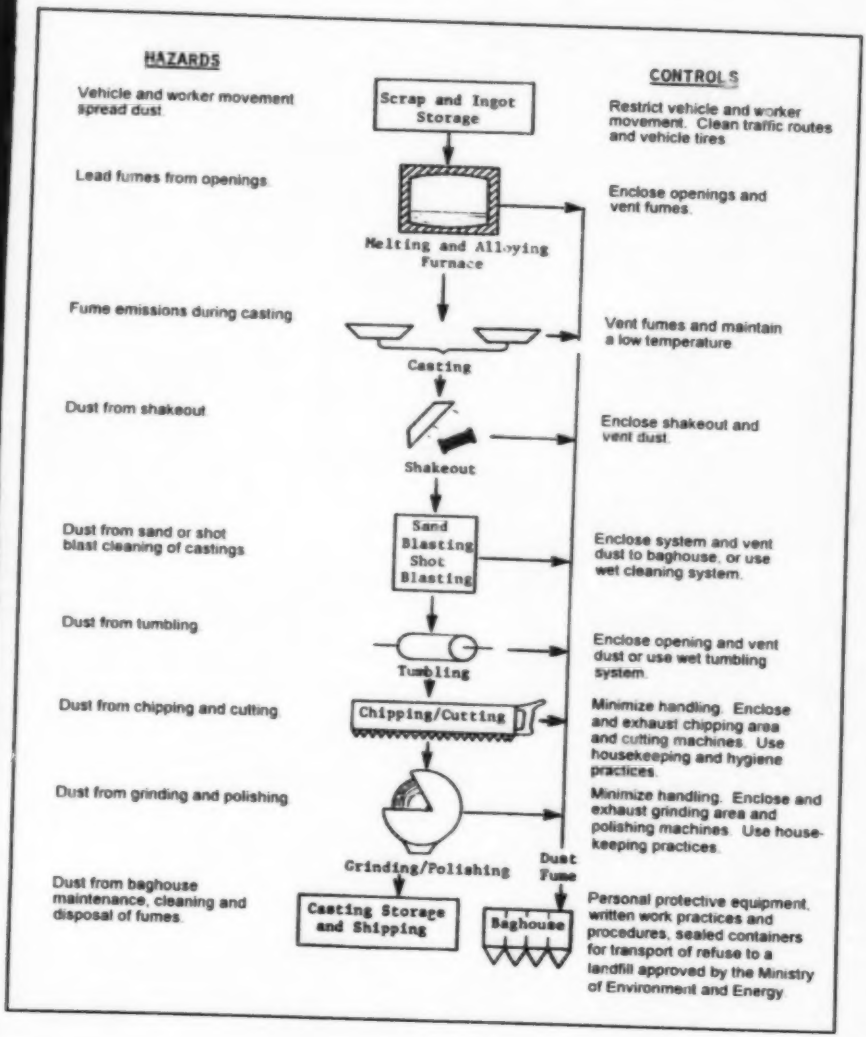
PROCESS FLOW SHEET FOR BATTERY MANUFACTURING


HAZARDS
CONTROLS
Vehicle and worker movement spread dust
Lead Ingot Storage
Restrict vehicle and worker movement. Clean traffic routes and vehicle tires.
High temperatures produce fumes
Melting Pots
Enclose openings, vent fumes and maintain a low temperature.
Fume emissions during casting
Small Parts Casting
Grid Casting
Slug Casting
Vent fumes and maintain a low temperature.
Milling
Dust produced during milling of lead slugs
Lead Oxide
Enclose system and vent dust to baghouse
Dust from maintenance, bag cleaning, duct cleaning and disposal of lead fines
Baghouse
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the Ministry of Environment and Energy.
Dust from dumping of lead oxide into mixers.
Paste Mixing
Enclose and exhaust mixer. Use housekeeping and hygiene practices.
Dried paste releases dust.
Pasting
Keep paste, floor and equipment wet and clean. Minimize paste handling.
to Assembly
to Drying
Dust to Baghouse

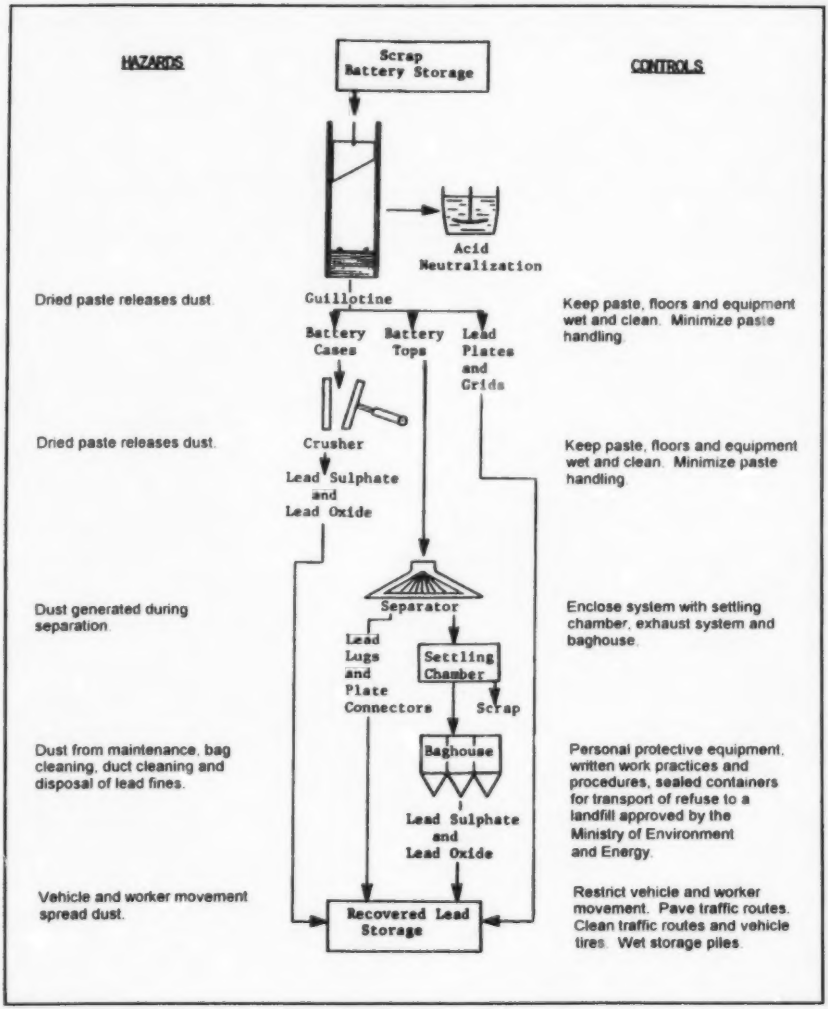
BATTERY MANUFACTURING PART 2


HAZARDS
CONTROLS
from Small Parts Casting
from Pasting
Dust from Paste Mixing
Drying
Dust from dried grids.
Minimize plate handling. Use housekeeping and hygiene practices.
Forming
Drying
Dust from dried grids.
Minimize plate handling. Use housekeeping and hygiene practices.
Plate Cutting
Dust from cutting, plate brushing and plate handling
Minimize plate handling. Enclose and exhaust cutting or brushing machines.
Assembly
Fumes from soldering and lug burning. Dust from handling plates, small parts and scrap.
Dust Fume
Vent dust and fumes from plate handling, lug burning and soldering. Use housekeeping and hygiene practices.
Baghouse
Dust from maintenance, bag cleaning, duct cleaning and disposal of lead fines.
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the Ministry of Environment and Energy.
Storage
Shipping

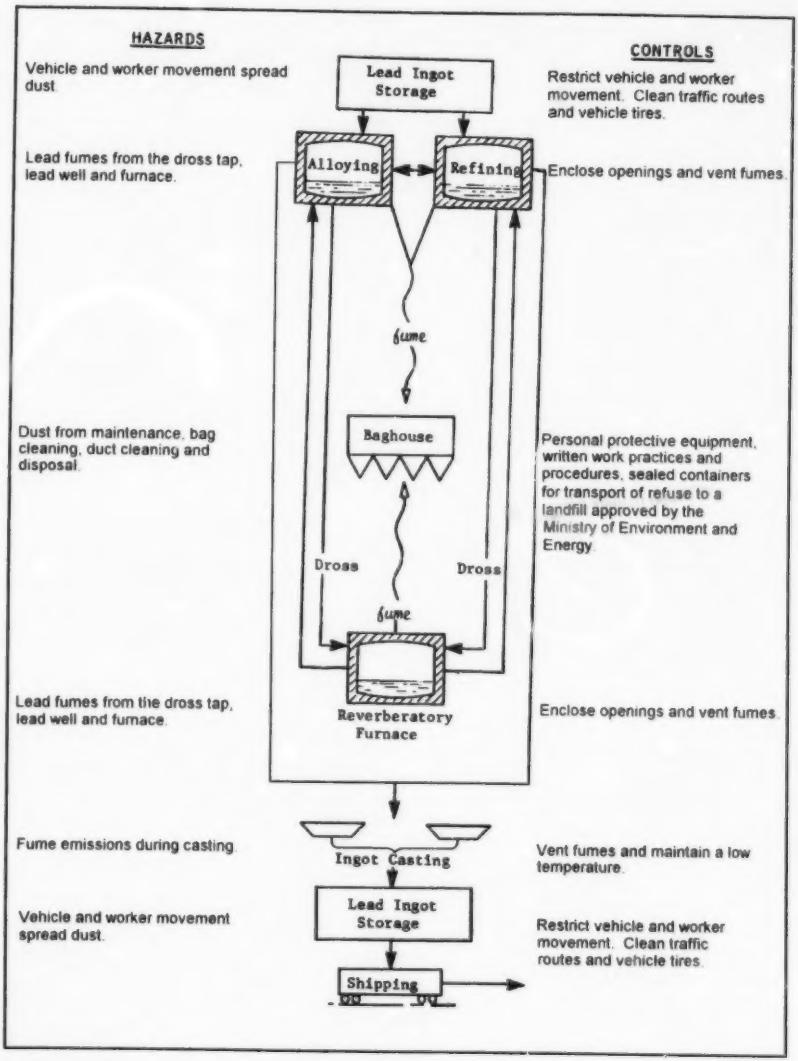
PROCESS FLOW SHEET FOR BRASS AND BRONZE FOUNDRY


HAZARDS
CONTROLS
Vehicle and worker movement spread dust
Scrap and Ingot Storage
Restrict vehicle and worker movement. Clean traffic routes and vehicle tires.
Lead fumes from openings
Enclose openings and vent fumes.
Melting and Alloying Furnace
Fume emissions during casting
Vent fumes and maintain a low temperature.
Casting
Dust from shakeout
Enclose shakeout and vent dust.
Shakeout
Dust from sand or shot blast cleaning of castings
Sand Blasting
Shot Blasting
Enclose system and vent dust to baghouse, or use wet cleaning system.
Dust from tumbling
Enclose opening and vent dust or use wet tumbling system.
Tumbling
Dust from chipping and cutting
Chipping/Cutting
Minimize handling. Enclose and exhaust chipping area and cutting machines. Use housekeeping and hygiene practices.
Dust from grinding and polishing
Minimize handling. Enclose and exhaust grinding area and polishing machines. Use housekeeping practices.
Grinding/Polishing
Dust Fume
Dust from baghouse maintenance, cleaning and disposal of fumes.
Casting Storage and Shipping
Baghouse
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the Ministry of Environment and Energy.

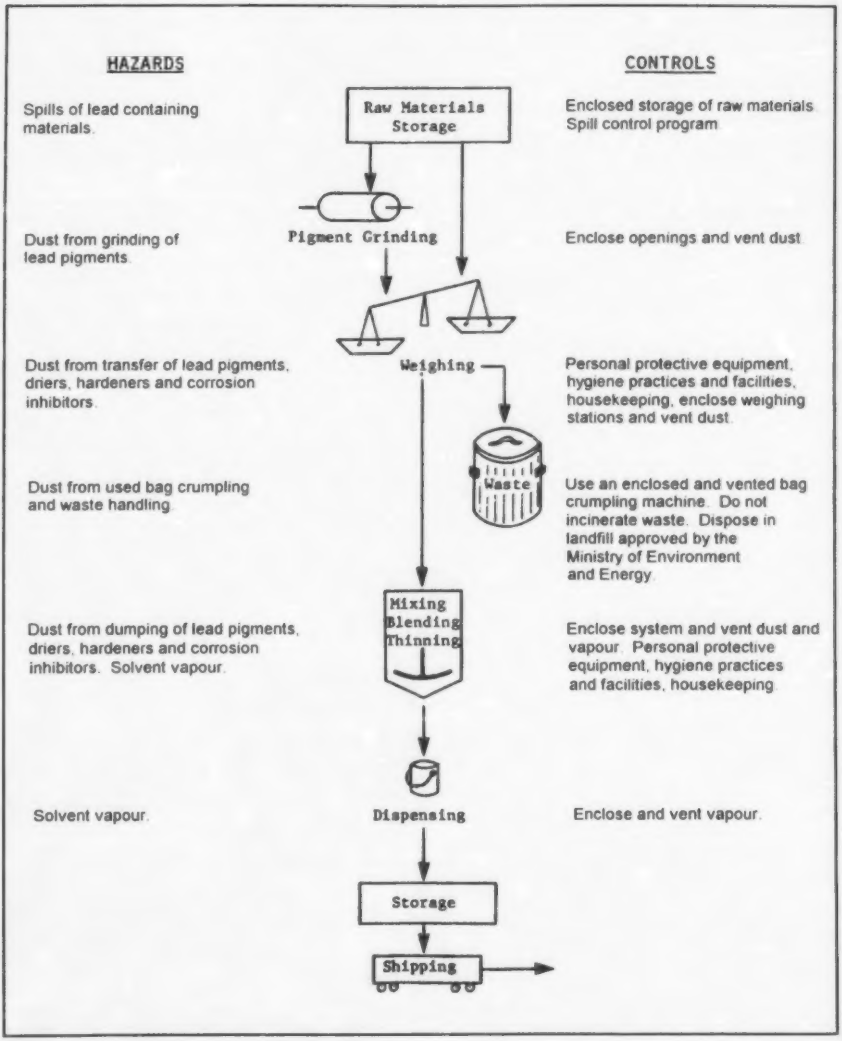
PROCESS FLOW SHEET FOR LEAD RECOVERY FROM BATTERIES


HAZARDS
CONTROLS
Scrap Battery Storage
Acid Neutralization
Dried paste releases dust.
Guillotine
Keep paste, floors and equipment wet and clean. Minimize paste handling.
Battery Cases
Battery Tops
Lead Plates and Grids
Dried paste releases dust.
Crusher
Keep paste, floors and equipment wet and clean. Minimize paste handling.
Lead Sulphate and Lead Oxide
Dust generated during separation.
Separator
Enclose system with settling chamber, exhaust system and baghouse.
Lead Lugs and Plate Connectors
Settling Chamber
Scrap
Dust from maintenance, bag cleaning, duct cleaning and disposal of lead fines.
Baghouse
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the Ministry of Environment and Energy.
Lead Sulphate and Lead Oxide
Vehicle and worker movement spread dust.
Recovered Lead Storage
Restrict vehicle and worker movement. Pave traffic routes. Clean traffic routes and vehicle tires. Wet storage piles.

PROCESS FLOW SHEET FOR LEAD REFINING AND ALLOYING


HAZARDS
CONTROLS
Vehicle and worker movement spread dust.
Lead Ingot Storage
Restrict vehicle and worker movement. Clean traffic routes and vehicle tires.
Lead fumes from the dross tap, lead well and furnace.
Alloying
Refining
Enclose openings and vent fumes.
fume
Dust from maintenance, bag cleaning, duct cleaning and disposal.
Baghouse
Personal protective equipment, written work practices and procedures, sealed containers for transport of refuse to a landfill approved by the Ministry of Environment and Energy.
Dross
Dross
fume
Lead fumes from the dross tap, lead well and furnace.
Reverberatory Furnace
Enclose openings and vent fumes.
Fume emissions during casting.
Ingot Casting
Vent fumes and maintain a low temperature.
Vehicle and worker movement spread dust.
Lead Ingot Storage
Restrict vehicle and worker movement. Clean traffic routes and vehicle tires.
Shipping

PROCESS FLOW SHEET FOR PAINT MANUFACTURE


HAZARDS
CONTROLS
Spills of lead containing materials.
Raw Materials Storage
Enclosed storage of raw materials. Spill control program.
Dust from grinding of lead pigments.
Pigment Grinding
Enclose openings and vent dust.
Dust from transfer of lead pigments, driers, hardeners and corrosion inhibitors.
Weighing
Personal protective equipment, hygiene practices and facilities, housekeeping, enclose weighing stations and vent dust.
Waste
Dust from used bag crumpling and waste handling.
Use an enclosed and vented bag crumpling machine. Do not incinerate waste. Dispose in landfill approved by the Ministry of Environment and Energy.
Mixing Blending Thinning
Dust from dumping of lead pigments, driers, hardeners and corrosion inhibitors. Solvent vapour.
Enclose system and vent dust and vapour. Personal protective equipment, hygiene practices and facilities, housekeeping.
Solvent vapour.
Dispensing
Enclose and vent vapour.
Storage
Shipping

Appendix 2 - Regulations made under the *Occupational Health and Safety Act* Revised Statutes of Ontario, 1990, Chapter O.1 as amended.

February 1, 2001

A. Safety Regulations

Construction Projects:	O. Reg. 213/91, as amended by O. Reg. 631/94, O. Reg. 143/99, O. Reg. 571/99, O. Reg. 145/00, and O. Reg. 527/00.
Industrial Establishments:	R.R.O. 1990, Reg. 851, as amended by O. Reg. 516/92, O. Reg. 630/94, O. Reg. 230/95, O. Reg. 450/97, O. Reg. 144/99, O. Reg. 284/99, and O. Reg. 528/00.
Mines and Mining Plants:	R.R.O. 1990, Reg. 854, as amended by O. Reg. 583/91, O. Reg. 584/91, O. Reg. 171/92, O. Reg. 384/92, O. Reg. 571/92, O. Reg. 693/92, O. Reg. 60/94, O. Reg. 779/94, O. Reg. 68/96, O. Reg. 272/97, O. Reg. 236/99 and O. Reg. 486/99.
Window Cleaning:	R.R.O. 1990, Reg. 859, as amended by O. Reg. 523/92.
Critical Injury Defined:	R.R.O. 1990, Reg. 834.
Training Requirements for Certain Skill Sets and Trades:	O. Reg. 572/99.
Diving Operations:	O. Reg. 629/94.
Firefighters—Protective Equipment:	O. Reg. 714/94, as amended by O. Reg. 449/97.
Health Care and Residential Facilities:	O. Reg. 67/93 as amended by O. Reg. 142/99.
Oil and Gas—Offshore:	R.R.O. 1990, Reg. 855.

Roll-Over Protective Structures:	R.R.O. 1990, Reg. 856.
Teachers:	R.R.O. 1990, Reg. 857.
University Academics and Teaching Assistants:	R.R.O. 1990, Reg. 858.

B. Designated Substances

Acrylonitrile:	R.R.O. 1990, Reg. 835, as amended by O. Reg. 507/92.
Arsenic:	R.R.O. 1990, Reg. 836, as amended by O. Reg. 508/92.
Asbestos:	R.R.O. 1990, Reg. 837, as amended by O. Reg. 509/92, O. Reg. 598/94 and O. Reg. 386/00.
Asbestos on Construction Projects and in Buildings and Repair Operations:	R.R.O. 1990, Reg. 838, as amended by O. Reg. 510/92.
Benzene:	R.R.O. 1990, Reg. 839, as amended by O. Reg. 511/92 and O. Reg. 387/00.
Coke Oven Emissions:	R.R.O. 1990, Reg. 840, as amended by O. Reg. 512/92.
Ethylene Oxide:	R.R.O. 1990, Reg. 841, as amended by O. Reg. 515/92.
Isocyanates:	R.R.O. 1990, Reg. 842, as amended by O. Reg. 518/92.
Lead:	R.R.O. 1990, Reg. 843, as amended by O. Reg. 519/92 and O. Reg. 389/00.
Mercury:	R.R.O. 1990, Reg. 844, as amended by O. Reg. 520/92 and O. Reg. 390/00.
Silica:	R.R.O. 1990, Reg. 845, as amended by O. Reg. 521/92 and O. Reg. 391/00.
Vinyl Chloride:	R.R.O. 1990, Reg. 846, as amended by O. Reg. 522/92 and O. Reg. 392/00.

C. General

Biological or Chemical Agents, Control of Exposure to:	R.R.O. 1990, Reg. 833, as amended by O. Reg. 513/92, O. Reg. 597/94 and O. Reg. 388/00.
Hazardous Materials Inventories:	R.R.O. 1990, Reg. 850, revoked by O. Reg. 397/93.
Workplace Hazardous Materials Information System:	R.R.O. 1990, Reg. 860, as amended by O. Reg. 36/93.

D. Hazardous Physical Agents

X-Ray Safety:	R.R.O. 1990, Reg. 861.

E. Regulations that Directly Affect/Impact the Act

Training Programs:	O. Reg. 780/94.
Unilateral Work Stoppage:	O. Reg. 243/95.
Inventory of Agents or Combinations of Agents for the Purpose of Section 34 of the Act:	R.R.O. 1990, Reg. 852, as amended by O. Reg. 517/92.
Joint Health and Safety Committees—Exemption from Requirements:	O. Reg. 385/96, as amended by O. Reg. 131/98.

NOTE:

For a complete reference to the Regulations made under the *Occupational Health and Safety Act*, please see the Annual Consolidated Index to the Regulations of Ontario.

Appendix 3 - Ministry of Labour Field Offices

CENTRAL REGION

Toronto North
1201 Wilson Ave
West Bldg, 2nd Fl
Downsview M3M 1J8
(416) 235-5330
Fax (416) 235-5080

Toronto West
1201 Wilson Ave
West Bldg, 2nd Fl
Downsview M3M 1J8
(416) 235-5330
Fax (416) 235-5090

Peel North
The Kaneff Centre, 1st Fl
1290 Central Pkwy West
Mississauga L5C 4R3
(905) 273-7800
*1-800-268-2966
Fax (905) 615-7098

Peel South
The Kaneff Centre, 1st Fl
1290 Central Pkwy West
Mississauga L5C 4R3
(905) 273-7800
*1-800-268-2966
Fax (905) 615-7098

Toronto East
2275 Midland Ave, Main Fl
Scarborough M1P 3E7
(416) 314-5300
Fax (416) 314-5410

Durham
209 Dundas St E, Ste 204
Whitby L1N 7H8
(905) 665-4979
*1-800-263-1195
Fax (905) 665-4983

Barrie
114 Worsley St, Ste 201
L4M 1M1
(705) 722-6642
*1-800-461-4383
Fax (705) 726-3101

York
1110 Stellar Drive, Unit 102
Newmarket L3Y 7B7
(905) 715-7020
*1-888-299-3138
Fax (905) 715-7140

EASTERN REGION

Ottawa West
1111 Prince of Wales Dr,
Ste 200
K2C 3T2
(613) 228-8050
*1-800-267-1916
Fax (613) 727-2900

Ottawa East
1111 Prince of Wales Dr,
Ste 200
K2C 3T2
(613) 228-8050
*1-800-267-1916
Fax (613) 727-2900

Kingston
Beechgrove Complex
51 Heakes Lane
K7M 9B1
(613) 545-0989
*1-800-267-0915
Fax (613) 545-9831

Peterborough
Robinson Place (MNR Bldg.)
300 Water St N
3rd Fl South Tower
K9J 8M5
(705) 755-4700
*1-800-461-1425
Fax (705) 755-4724

NORTHERN REGION

Sudbury West
159 Cedar St, Ste 301
P3E 6A5
(705) 564-7400
*1-800-461-6325
Fax (705) 564-7435

Sudbury East
159 Cedar St, Ste 301
P3E 6A5
(705) 564-7400
*1-800-461-6325
Fax (705) 564-7435

Sault Ste. Marie
70 Foster Dr, Ste 480
P6A 6V4
(705) 945-6600
*1-800-461-7268
Fax (705) 949-9796

Elliot Lake
50 Hillside Dr N
P5A 1X4
*1-800-461-7268
Fax (705) 848-8055

Thunder Bay
435 James St S, Ste 222
P7E 6S7
(807) 475-1691
*1-800-465-5016
Fax (807) 475-1646

Dryden
479 Government Rd
P8N 3B3
(807) 223-4898
*1-800-465-5016
Fax (807) 223-4344

Timmins
(mailing address)
P.O. Bag 3050
South Porcupine P0N 1H0

(office address)
Ontario Government Complex
D Wing
Highway 101 E
Porcupine P0N 1C0
(705) 235-1900
*1-800-461-9847
Fax (705) 235-1925

Kapuskasing
c/o MNR
RR #2, Hwy 17 W
P5N 2X8
(705) 235-1900
*1-800-461-9847
Fax (705) 335-8330

North Bay
447 McKeown Ave, 2nd Fl
P1B 9S9
*1-800-461-6325
Fax (705) 497-6850

WESTERN REGION

Hamilton
1 Jarvis St, Main Fl
L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1200

Brant
1 Jarvis St, Main Fl
Hamilton L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1324

Halton
1 Jarvis St, Main Fl
Hamilton L8R 3J2
(905) 577-6221
*1-800-263-6906
Fax (905) 577-1324

Niagara
301 St. Paul St, 8th Fl
St. Catharines L2R 7R4
(905) 704-3994
*1-800-263-7260
Fax (905) 704-3011

London North
217 York St, 5th Fl
N6A 5P9
(519) 439-2210
*1-800-265-1676
Fax (519) 672-0268

London South
217 York St, 5th Fl
N6A 5P9
(519) 439-2210
*1-800-265-1676
Fax (519) 672-0268

Kitchener
155 Frobisher Dr, Unit G213
Waterloo N2V 2E1
(519) 885-3378
*1-800-265-2468
Fax (519) 883-5694

Windsor
250 Windsor Ave, Ste 635
N9A 6V9
(519) 256-8277
*1-800-265-5140
Fax (519) 258-1321

MAIN OFFICE

Toronto
400 University Ave, 7th Fl
M7A 1T7

Occupational Health and Safety Branch - (416) 326-7770

Construction Health and Safety Program - (416) 326-2439

Industrial Health and Safety Program - (416) 326-2445

Professional and Specialized Services - (416) 326-2443

Fax (416) 326-7761

Mining Health and Safety Program
Willet Green Miller Centre
Building B
933 Ramsey Lake Rd
Sudbury P3E 6B5
(705) 670-5695
Fax (705) 670-5698

Material Testing Laboratory
Willet Green Miller Centre
Building C
933 Ramsey Lake Road
Sudbury P3E 6B5
(705) 670-5695
Fax (705) 670-5698

Radiation Protection Service
81A Resources Rd
Weston M9P 3T1
(416) 235-5922
Fax (416) 235-5926

Publications
400 University Ave, 7th Fl
Toronto M7A 1T7
(416) 326-7731
*1-800-268-8013 ext 6-7731
[province-wide]
Fax (416) 326-7745

Toll-Free Number [Note: Many of these "1-800" numbers are accessible only within the area code of the relevant office.]

For inquiries please contact the Ministry of Labour office nearest to you. Consult the blue pages in your local telephone directory for additional information

NOTES